

The disclosed embodiments of the invention will now be discussed in comparison to the prior art. Of course, the discussion of the disclosed embodiments, and the discussion of the differences between the disclosed embodiments and the prior art subject matter, do not define the scope or interpretation of any of the claims. Instead, such discussed differences merely help the Examiner appreciate important claim distinctions discussed thereafter.

Applicant discloses a microelectronic substrate with implanted materials that allows accurate detection of an endpoint of chemical mechanical planarization of such substrates, particularly those having complex topographies (i.e., as a plurality of recesses and raised surfaces) that must be polished to form a uniform blanket surface. In the disclosed embodiments, a relatively small amount of the endpoint detection material is implanted beneath the surface of the microelectronic substrate at a depth "d" which, when reached by the planarizing process, is indicative of having achieved a blanket surface for the microelectronic substrate. In addition, the endpointing material is implanted in a specified thickness "t" at the selected depth d below the surface of the microelectronic substrate. The implanted substance is implanted at a concentration that does not affect the electrical properties of the microelectronic substrate, for example at about 0.0001% to about 0.1%. Typically, the distance d is about 200 Å and the thickness t is about 100 to 500 Å, so that the endpointing material is detected across substrates having complex surface topologies. During CMP of the microelectronic substrate, the materials released into the slurry are monitored by vaporization of a sample of the slurry using mass spectroscopy, emission spectrometry or similar species analyzers. The first detection of the endpointing material at the first depth d indicates that planarization has gone at least to the predetermined depth. The last detection of the endpointing material indicates that planarization has continued at least to a depth equal to the thickness t of the endpointing material beneath the surface, indicating that planarization has formed a blanket surface and is therefore complete.

Although Naoki discloses a CPM apparatus configured with a mass spectrometer for detecting the endpoint of CMP, Naoki fails to disclose such an apparatus figured with the type of microelectronic substrate described by Applicant. More particularly, as the Examiner notes, the microelectronic substrate of the device of Naoki includes a layer of P doped SiO<sub>2</sub> over a layer of undoped SiO<sub>2</sub>. The undoped SiO<sub>2</sub> layer is not a second substance *implanted* at specified depth d and a thickness t below the surface of the substrate. The apparatus of Naoki is

thus configured with a different type of microelectronic substrate, so that the detection of the endpoint of planarization is not based on detecting the beginning and end of the implanted substance within the lower layer, but on detecting the disappearance of the doped substance from the upper layer. Moreover, the doped upper layer would not reasonably be considered to be the same as substance of 0.0001% to 0.1% implanted in a lower layer that does not affect the electrical properties of the microelectronic substrate since doping of the upper layer is precisely for the purpose of altering the electrical properties of the upper layer.

With respect to Meikle, that reference is directed only at detecting the presence of a second titanium layer beneath a first layer lacking titanium, however, the titanium is the second layer, it is not a substance *implanted* at a distance  $d$  below the surface of the first layer. To be implanted means that a first substance is placed within a second substance.

Turning now to the claims, Applicant has amended base claim 68 to clearly indicate that the claimed apparatus not only includes the recited planarizing apparatus, but specifically refers to such an apparatus configured with the novel type of microelectronic substrate having an endpointing substance (second substance) implanted beneath the top surface of a first substance at a depth  $d$  and thickness  $t$ . As mentioned above, Naoki discloses a device configured with a microelectronic substrate having P doped SiO<sub>2</sub> layer on top of undoped SiO<sub>2</sub>, which is a conventional microelectronic substrate. The undoped SiO<sub>2</sub> layer is not a second substance implanted at a specified depth  $d$  and thickness  $t$  below the surface of the first substance. Similarly Meikle fails to disclose a microelectronic substrate with an implanted endpointing material therebelow, and therefore fails to disclose a CMP apparatus configured with such a microelectronic substrate.

The remaining new claims further limit the base claim and are patentable at least for this reason. In addition, Applicant has added new claims 73-88 to further limit the structure of the first and/or second substances of the microelectronic substrate which is a novel element recited in base claim 68. Applicant notes that these new dependent claims, as with the amendment to the base claim, include elements analogous to the elements of the novel type of microelectronic substrate that was deemed allowable in the sibling divisional application to the present application, which was also examined by the present Examiner. Because the

microelectronic substrate is patentable, Applicant submits that the apparatus configured with such a microelectronic substrate is also patentable.

Attached hereto is a marked-up version of the changes made to the claims by the current amendment. The attached page is captioned "Version with Markings to Show Changes Made".

All of the claims remaining in the application are now clearly allowable. Favorable consideration and a Notice of Allowance are earnestly solicited.

Respectfully submitted,

DORSEY & WHITNEY LLP



Mark W. Roberts, Ph.D.  
Registration No. 46,160

MWR:sj

Enclosures:

Postcard  
Check  
Fee Transmittal Sheet (+ copy)

1420 Fifth Avenue, Suite 3400  
Seattle, WA 98101-4010  
(206) 903-8800 (telephone)  
(206) 903-8820 (fax)

\\sefile05\files2\ip\documents\clients\micron technology\400\500431.04\500431.04 amendment 042902.doc

VERSION WITH MARKINGS TO SHOW CHANGES MADE

68. (Amended) An apparatus for detecting the endpoint of a planarizing process [of] comprising a microelectronic substrate having a top surface formed of a first substance, and a second substance, the second substance being implanted at a distance d as a layer with a thickness t beneath [a] the top surface of the microelectronic substrate, the [apparatus comprising:] microelectronic substrate being configured with;

a planarizing device having a first portion and a second portion movable relative to the first portion to remove material from the microelectronic substrate positioned therebetween, the material including atoms of the first and second substances;

transport means to move the material from the planarizing device; and

a mass spectrometer coupled to the transport means to receive the material and detect the atomic mass of the second substance.